

CLAIMS

What is claimed is:

1. A microwave/millimeter-wave monolithic integrated  
5 circuit device, comprising:  
a semiconductor substrate;  
at least one first mesa portion and at least one  
second mesa portion, the first and second mesa portions  
being formed on the substrate;  
10 at least one PIN diode, the PIN diode being formed  
on the first mesa portion and including a PIN anode  
region;  
at least one Schottky diode, the Schottky diode  
being formed on the second mesa portion and including a  
15 Schottky anode region; and  
a passivation layer deposited on the substrate to  
cover the PIN diode, the Schottky diode, the first mesa  
portion, and the second mesa portion while providing  
access to at least the PIN anode region and the Schottky  
20 anode region,  
wherein the PIN anode region is formed in  
approximately the same plane as the Schottky anode  
region.
- 25 2. The microwave/millimeter-wave monolithic integrated  
circuit device of claim 1 wherein the semiconductor  
substrate comprises a silicon substrate.

3. The microwave/millimeter-wave monolithic integrated circuit device of claim 1 wherein the passivation layer comprises a low-loss glass passivation layer.
- 5 4. The microwave/millimeter-wave monolithic integrated circuit device of claim 1 wherein the Schottky anode region is formed subsequent to the deposition of the passivation layer.
- 10 5. The microwave/millimeter-wave monolithic integrated circuit device of claim 1 wherein the Schottky anode region includes a thin epitaxial layer formed by an ultra-high vacuum chemical vapor deposition process.
- 15 6. The microwave/millimeter-wave monolithic integrated circuit device of claim 5 wherein the thin epitaxial layer of the Schottky anode region has a thickness equal to about 0.1  $\mu\text{m}$ .
- 20 7. The microwave/millimeter-wave monolithic integrated circuit device of claim 1 wherein the first and second mesa portions are formed on the substrate by way of a single anisotropic etching operation.
- 25 8. A method of fabricating a microwave/millimeter-wave monolithic integrated circuit device including at least one PIN diode and at least one Schottky diode, comprising the steps of:
- providing a semiconductor substrate;

forming at least one first mesa portion and at least one second mesa portion on the substrate;

forming the PIN diode including a PIN anode in a PIN diode region of the substrate, the PIN diode being formed  
5 on the first mesa portion;

forming the Schottky diode including a Schottky anode in a Schottky diode region of the substrate, the Schottky diode being formed on the second mesa portion, the Schottky anode being formed in approximately the same  
10 plane as the PIN anode; and

depositing a passivation layer on the substrate to cover the PIN diode, the Schottky diode, the first mesa portion, and the second mesa portion while providing access to at least the PIN anode and the Schottky anode.  
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9. The method of claim 8 wherein the providing step includes providing a silicon substrate.

10. The method of claim 8 wherein the depositing step  
20 includes depositing a low-loss glass passivation layer on the substrate.

11. The method of claim 8 wherein the first forming step includes forming the first mesa portion and the second  
25 mesa portion on the substrate by way of a single anisotropic etching operation.

12. The method of claim 11 wherein the first forming step includes depositing a layer of silicon nitride on

- the PIN diode region and the Schottky diode region of the substrate, masking portions of the PIN diode region and the Schottky diode region that are to become the first and second mesa portions, etching the silicon nitride layer except in the masked portions of the PIN diode and Schottky diode regions, and conducting the single anisotropic etching operation to form the first and second mesa portions on the substrate.
- 10 13. The method of claim 8 wherein the second forming step includes etching an implant window for the PIN anode in the PIN diode region of the substrate while masking the Schottky diode region of the substrate, and implanting a dopant through the implant window for the PIN anode in the PIN diode region of the substrate while masking the Schottky diode region of the substrate.
- 15 14. The method of claim 8 wherein the third forming step includes forming the Schottky anode subsequent to the deposition of the passivation layer.
- 20 15. The method of claim 14 wherein the third forming step includes forming a thin epitaxial layer of the Schottky anode in the Schottky diode region of the substrate by an ultra-high vacuum chemical vapor deposition process while masking the PIN diode region of the substrate.
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